CTPS TECHNICAL REPORT 41

PARKING DEMAND PROJECTIONS FOR THE ROUTE 128 RAILROAD STATION

June 1983

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ABSTRACT This report develops parking demand projections for the Route 128 Railroad Station. The report deals separately with the AMTRAK, commuter rail, and carpool markets. The AMTRAK parking projections were made using modifications of forecasts from the Northeast Corridor Improvement Project. The commuter rail and carpool parking projections were made using the calibrated mode split model for the Boston Region and a mode split model calibrated on national figures. The report estimates the maximum probable demand for parking, at Route 128 Station under the most extreme conditions projected from all market segments.

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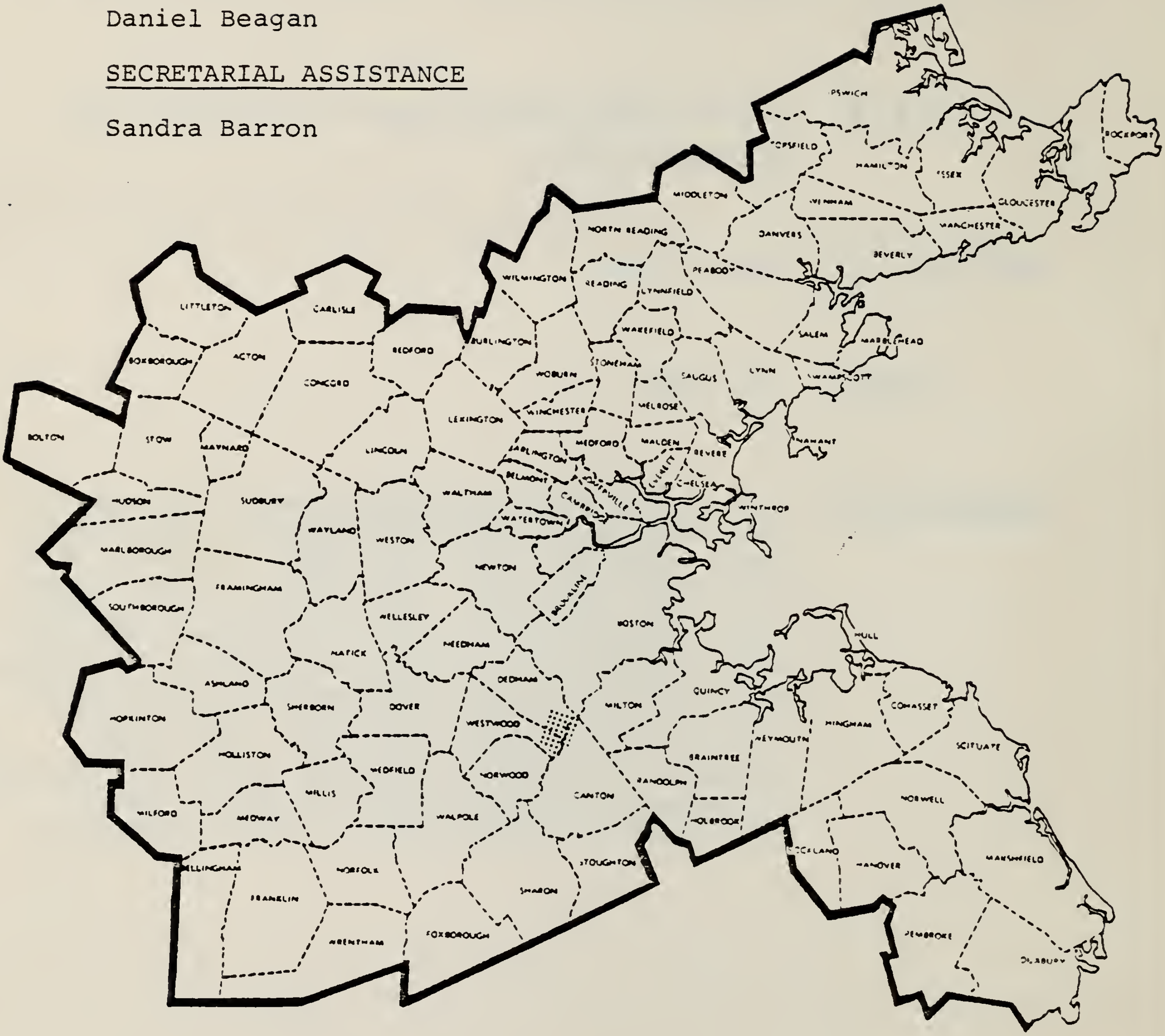

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1.0 INTRODUCTION

The purpose of this report is to examine the long-range demand for parking at the Route 128 railroad station, in light of the MBTA's proposal to lease the land and/or air rights at that station. The Request for Proposal specified that a minimum of 750 parking spaces must be provided for rail patrons by the developer. Concern has been raised that this minimum is below the long-range demand for parking.

The current parking at this station is made up of three markets: commuter rail passengers, AMTRAK long-distance passengers, and carpoolers. This report will examine the demand for parking from each of these markets, relying heavily on previously-published reports.

2.0 EXISTING CONDITIONS AT ROUTE 128 STATION

2.1 THE PHYSICAL FACILITY

The current station at Route 128 has a paved at-grade parking lot of approximately 6.8 acres, with an aproximate capacity of 700 spaces (Reference 1, page 20). The long-term lot of 695 spaces is supervised by an attendant, and a parking fee of $1 per day is charged at time of exit. There is also a separate live parking area for approximately 30 vehicles for drop-off (kiss-and-ride) trips.

The station structures consist of a 4,000-square foot main station, which provides a ticket office and a waiting area for southbound passengers. A smaller 1,500-square foot shelter is provided for northbound passengers. A pedestrian overpass over the train tracks is provided between the two structures (Reference 3, page 18-9). The station structures, as well as the land including the parking lots, is owned by the MBTA.

The station is served by 44 passenger trains daily, and an additional 8 passenger trains pass by the station without stopping (see Table 2-1). Of the trains stopping at the station, four commuter trains stop during the AM peak (6:30 AM to 8:30 AM) in the peak direction (northbound) and four southbound during the PM peak (4:30 PM to 6:30 PM).

Of the AMTRAK trains, one train in the peak direction stops during each of the peak periods. The number of commuter trains making stops is up from 11 in each direction in 1975, although the number of peak-hour trains is unchanged. The number of AMTRAK trains making stops is down from 11 in 1975 (Reference 1). The schedule time from Route 128 to South Station is 20 minutes by both commuter rail and AMTRAK.

The existing fare structure for commuter rail patrons to Boston is $1.50 one way. This represents the base fare of $1.25 and $.25 fare for each additional fare zone. Route 128 is located in Fare Zone 2. Proceeding south from Route 128 Station, Canton Junction is in Fare Zone 3 and Sharon is in Fare Zone 4. North from Route 128, Readville is also in Fare Zone 2, while Fairmount Station (the Hyde Park Station replacement during Southwest Corridor construction) is in Fare Zone 1. For all commuters, a discount of 9 percent per trip can be realized by purchasing a 12-ride ticket, and a discount of 22 percent per trip can be realized by purchasing a monthly pass, which is also good on all MBTA transit services. Route 128 is also the only station in the Southwest Corridor which charges a fee for parking. This increases the total train fare from this station by $.50 on a one-way basis.

	Commuter Rail*		AMTRAK**		
	South Bound	North Bound	South Bound	North Bound	Total
Station Stop	14	14	8	8	44
Pass By	3	3	1	1	8
Total	17	17	9	9	52

Source: *MBTA Commuter Rail Schedule, January 3, 1983.
**AMTRAK Train Timetables, October 31, 1982, through April 23, 1983.

Table 2-1

Passenger Trains at Route 128

City or Town of Origin	Route 128*	Route 128**	Canton Junction**	Sharon**
Acton	-	1		
Avon	-	-	3	
Attleboro	-	2		
Boston	3	-	2	
Braintree	1	-		
Bridgewater	-	1		
Brockton	7	3	1	
Canton	21	12	22	
Cohasset	-	1		
Concord	-	1		
Dedham	3	8		
Dover	-	1		
Easton	2	-	5	1
Foxborough	3	-	1	3
Franklin	1	1		
holbrook	1	2		
Lincoln	-	1		
Mansfield	1	1		
Mattapoisett	1	-		
Medfield	1	3		
Milford	-	1		
Millis	1	2	1	
Needham	3	2		
Newton	1	1		
Norfolk	1	-	1	1
North Attleboro	2	2		
Norton	1	-		
Norwood	6	10	4	
Plainville	-	1		
Randolph	3	3		
Raynham	1	1		
Sharon	2		3	9
Sherborn	3	-		
Stoughton	3	1	28	1
Walpole	14	10	2	1
Waltham	1	-		
Westwood	29	17		
Whitman	1	-		
Wrentham	1	1		
Central Massachusetts	-	1		
Rhode Island	7	4		
Connecticut	-	1		
No Response	-	5	13	
	124	101	86	16

Source: *Reference 1.
**Reference 9.

ORIGIN TOWN BY BOARDING STATION

TABLE 2-2

	Brockton	Canton	Dedham	Norwood	Walpole	Westwood	Other Towns
Sharon	-	3	-	1	11	-	249
Route 128	7	21	3	6	14	29	41
Readville	-	-	1	-	-	-	12
Hyde Park	-	-	-	-	-	-	17
Mount Hope	-	-	-	-	-	-	1
Stoughton	38	-	-	-	-	-	155
Canton Junction	4	100	12	4	3	-	69
Canton Center	2	1	-	-	-	-	18
Walpole	-	-	-	-	25	-	14
Plimptonville	-	-	-	-	4	-	0
Windsor Garden	1	-	-	62	-	-	1
Norwood Center	-	-	-	91	29	5	7
Norwood Depot	-	-	-	78	6	3	3
Islington	-	-	6	1	-	50	0
Endicott	-	-	146	-	1	-	2
Needham Junction	-	-	6	-	1	12	162
Birds Hill	-	-	-	-	-	-	172
West Roxbury	-	-	3	-	-	-	63
Highland	-	-	-	-	-	-	46
Bellevue	-	-	-	-	-	-	36
Roslindale	-	-	2	-	-	-	71
Total	52	125	179	243	94	99	NA
Route 128 Response as Percent of Town	13%	17%	2%	2%	15%	29%	NA

Source: Reference 9.

TABLE 2-3

STATION BOARDINGS FROM CATCHMENT AREA TOWNS

2.2 EXISTING PATRONAGE

Current estimates of patronage at Route 128 Station are 220 AMTRAK boardings (Reference 7) and 609 commuter rail boardings (Reference 9). The 1974 patronage at Route 128 Station was 150 AMTRAK boardings and 379 commuter rail boardings. The demand for parking at the station is assumed to be at least 400 spaces per day.

Based on information from the TAMS Commuter Rail Survey, documented in a CTPS Technical Report (November 1976, Reference 9) and on a survey conducted by David A. Crane and partners, Incorporated (Reference 2) presented in Table 2-2, Route 128 Station serves more of a regional market than other commuter rail stations, largely because of its accessibility from the regional expressways.

At Canton Junction, almost 70 percent of the survey responses were from just two communities (Canton and Stoughton) and from Sharon, 80 percent of the responses were also from just two communities (Foxborough and Sharon). At Route 128, however, the highest two communities (Westwood and Canton) have no more than 40 percent of the responses.

The six highest communities (Brockton, Canton, Dedham, Norwood, Walpole, and Westwood) have 65 percent of the responses in the TAMS survey and 62 percent of the responses in the DACP survey. Five of these six communities (all except Dedham) were defined as the ridership catchment area in the previous 1979 CTPS report (Reference 10). For the purposes of this report, it is suggested that the six communities be defined as the catchment area for commuter rail service.

As is shown in Table 2-3, Route 128 Station is not the dominant boarding station even in the catchment area towns. It attracts no more than 30 percent of the station boardings from any single town. This supports the assumption that the station is more important as a regional station than as a local commuter rail station.

The dominant existing mode of access to Route 128 Station is by automobile. Over 80 percent of the passengers at Route 128 drove alone or carpooled and parked at the station, and the remainder were dropped off by an automobile (kiss-and-ride). The average auto occupancy for parkers is 1.1 persons/vehicle.

The destination of Route 128 commuter train trips is overwhelmingly to the Boston Central Business District (CBD). Ninety (90) percent of the trips are to the CBD, with 5 percent bound for the Back Bay area, 1.5 percent to Cambridge, and the remainder for other locations.

3.0 AMTRAK PATRONAGE ESTIMATES

3.1 BACKGROUND OF PAST ESTIMATES

Long-range estimates of AMTRAK intercity ridership have been prepared as part of the Northeast corridor High Speed Rail Passenger Service Improvement Project. These estimates have been prepared for two phases of rail improvements. The first phase, which is formally identified as the Northeast Corridor Improvement Project (NECIP), will reduce the travel time from Boston to New York from the current 4 hours, 55 minutes, to 3 hours, 40 minutes. The second phase, as called for in the Rail Revitalization and Regulatory Reform Act (4R Act), sets a goal of 3 hours from Boston to New York.

Three separate demand models have been used to estimate the intercity rail ridership. These models and their forecasts were prepared by Bechtel Incorporated (Reference 6), Peat, Marwick, Mitchell, and Company (Reference 5), and the Aerospace Corporation (Reference 17). Of these models, only the Bechtel and the PMM deal with the faster 4R Act rail times. Of these two models, the Bechtel model is documented more completely in published reports and deals with Boston-based trips more specifically. The purpose of this analysis is to identify the highest reasonable rail passenger demand at Route 128 Station. It is felt that an examination of the Bechtel model will best suit this purpose.

Upon review of that demand methodology, it has become apparent that its forecast parking needs at Route 128 Station may be overstated. The estimated need of 1,300 spaces for AMTRAK patrons in 1990 (Reference 4) was made using several assumptions, which now appear questionable. Inherent in the method is the calculation of lower parking demands if other assumptions had been made. This section will attempt to briefly describe the Bechtel demand model and to give the full range of parking needs it forecasts.

3.2 DESCRIPTION OF THE FORECASTING METHODOLOGY

The Bechtel methodology for estimating North East Corridor rail patronage is a multi-step process. Rather than simultaneous solving for patronage on all modes, the method identifies existing market shares for air, bus, and auto that might be diverted to rail and, in sequence, solves for these diversions based on rail improvements. Because the method assumes high and low parameters for most steps, it actually provides a wide range of forecasts.

3.2.1 Growth Forecasts

The first step in the forecasting process used was to project total intercity passenger volumes. For this step, a model was used, which forecast intercity traffic growth based on the growth of population and income. Two growth assumptions were made. The first assumed income growth equal to the growth rate achieved during the period 1957-1972. It assumed population growth equal to 1.07 percent per year.

The second assumption was for income growth equal to the average rate achieved over the period 1929-1972 and population growth equal to .67 percent per year. The results of this step are a projected annual corridor total of 121,640,000 passenger trips (low) to 148,326,000 trips (high). The trips to and from Boston are projected to be 28,326,000 (low) to 34,544,000 (high). All forecasts are for 1990.

3.2.2 Application of Existing Mode Shares

Because the procedure is a diversion process, it is first necessary to determine the base ridership for all modes, without any rail improvements. This was accomplished by applying the existing (1974) modal use percentages to the forecast total trips. This results in annual rail trip forecasts of 948,500 (low growth) to 1,154,000 (high growth) to and from Boston.

3.2.3 Air/Bus to Rail Diversion

The diversion of trips from air or bus to rail was based on the ratio of the projected intercity rail travel times (4R Act) to the respective air and bus times. It was assumed that air and metro-liner service would compete for the same market, and bus and conventional rail service would compete for the same market--each solely on the basis travel time ratios. A diversion curve for each market was calibrated based on the 1973 modal usage. From the diversion curve and the ratio, the new rail diversion was calculated. In both cases, it was assumed that the relative fares of each mode would remain the same.

3.2.4 Auto to Rail Diversion

For the diversion of auto trips, a slightly different procedure was used. The procedure assumes that only auto trips with one or two persons per car are divertable to rail. For higher occupancy rates, the economics in favor of auto use remain overwhelming. Further, it is assumed that only 50 percent of the two-person auto trips are divertable to rail. This results in a potential market for rail equal to 42 percent of auto trips. The actual diversion of auto trips is given for two cases (see Figure 3-1, Step 3). The first assumption, resulting in a high-auto diversion, is that constant dollar auto-operating costs would double, while rail fares would remain the same. The low assumption is that the constant dollar costs of both rail and auto would remain the same.

STEP 1: AIR-RAIL MODE DIVERSION (METROLINER-TYPE SERVICE)

$$\text{Total Rail Trips in Air-Rail Market Segment with Rail Improvements} = \text{Forecast (Base-Bound Metroliner) Air and Rail Trips} * f\left(\frac{\text{Improved Travel Time Rail}}{\text{Travel Time Rail}}\right)$$

Function = Diversion Curve - Percent Rail

STEP 2: BUS-RAIL MODE DIVERSION (CONVENTIONAL RAIL)

$$\text{Total Rail Trips in Bus-Rail Market Segment with Rail Improvements} = \text{Forecast (No-Build Conventional) Bus and Rail Trips} * f\left(\frac{\text{Improved Rail Travel Time}}{\text{Bus Travel Time}}\right)$$

Function = Diversion Curve - Percent Rail

STEP 3: AUTO-RAIL MODE DIVERSION

$$\text{Total New Rail Trips Diverted from Auto Trips} = \text{Forecast (No-Build) Auto Trips} * f\text{ (Travel Distance)}$$

	Low		High			
	2.9%	or	5.0%	Distance	50 Miles	
Function =	(6.3%		10.5%	50	Distance	100 Miles
	10.5%		20.9%	Distance	100 Miles	

Note: The high scenario assumes auto-operating costs double; rail, same low scenario assumes continued level of auto and rail costs.

STEP 4: INDUCED TRIPS

Induced Trips = Total New Rail Trips After Diversions * F (Corridor)

	Low		High	
Where f (Corridor) =	(7%	or	15%)	Boston - New York Corridor
	10%	or	25%	Boston Trips - New York/Washington Corridor

FIGURE 3-1

NORTHEAST CORRIDOR METHODS FOR ESTIMATING FUTURE RAIL PATRONAGE

3.2.5 Induced Rail Trips

After all of the diversions to rail are made, there is a range of annual rail trips of 3,588,000 to 5,932,500. A further assumption that improved rail would result in induced trips is made (also with a high and low range, see Figure 3-1, Step 4), which results in final annual Boston-based rail estimates ranging from 3,785,000 to 6,909,500 trips. The results of all of these steps is shown in Figure 3-2.

3.2.6 Allocation of Annual Trips to Design Day

Given the annual rail ridership to and from boston, the conversion to daily parking demand was accomplished in the following manner. First, the two-way trips were divided by two to convert them to one-way trips. Next, a factor was applied to convert annual trips to design-day trips. Excluding holiday-related travel, the peak ridership on the existing rail service is on Fridays, where daily demand is equal to .38 percent of annual ridership. The Monday through Thursday demand is .32 percent of annual ridership. Depending on the design-day chosen (Friday or Monday through Thursday), the appropriate factor is applied to annual ridership.

3.2.7 Allocation of Daily Metropolitan Trips to Route 128 Station

Finally, the Boston daily boardings must be allocated to Route 128 and South Station. The Bechtel procedure made two assumptions for suburban station use. A high forecast of Route 128 Station use was set at 30 percent of the metropolitan area rail trips and a low forecast at 15 percent. (Existing use was 12.5 percent.) The last step was to apply the existing parking demand at Route 128 Station (70 percent of boardings) to the passenger forecast to arrive at the parking estimate.

A more reasonable alternative method for assigning the Boston boardings to Route 128 Station and boardings at Route 128 to parking spaces might be to apply the existing station use to the forecasts. As shown in Table 3-3, 8.7 percent of all rail trips in the Boston area park at Route 128 Station.

3.3 ANALYSIS OF FORECASTS

The final results for parking space requirements at Route 128 Station for all assumptions are shown in Table 3-4. The demand ranges from 526 to 2,750 spaces. For the purpose of identifying parking space requirements, this range is too broad. it should be narrowed by eliminating those assumptions known to be invalid.

3.3.1 Growth Forecasts

The first assumption, which must be questioned, is that of high income and population growth. The 1980 U. S. Census has shown the annual population growth in the Boston Standard Consolidated

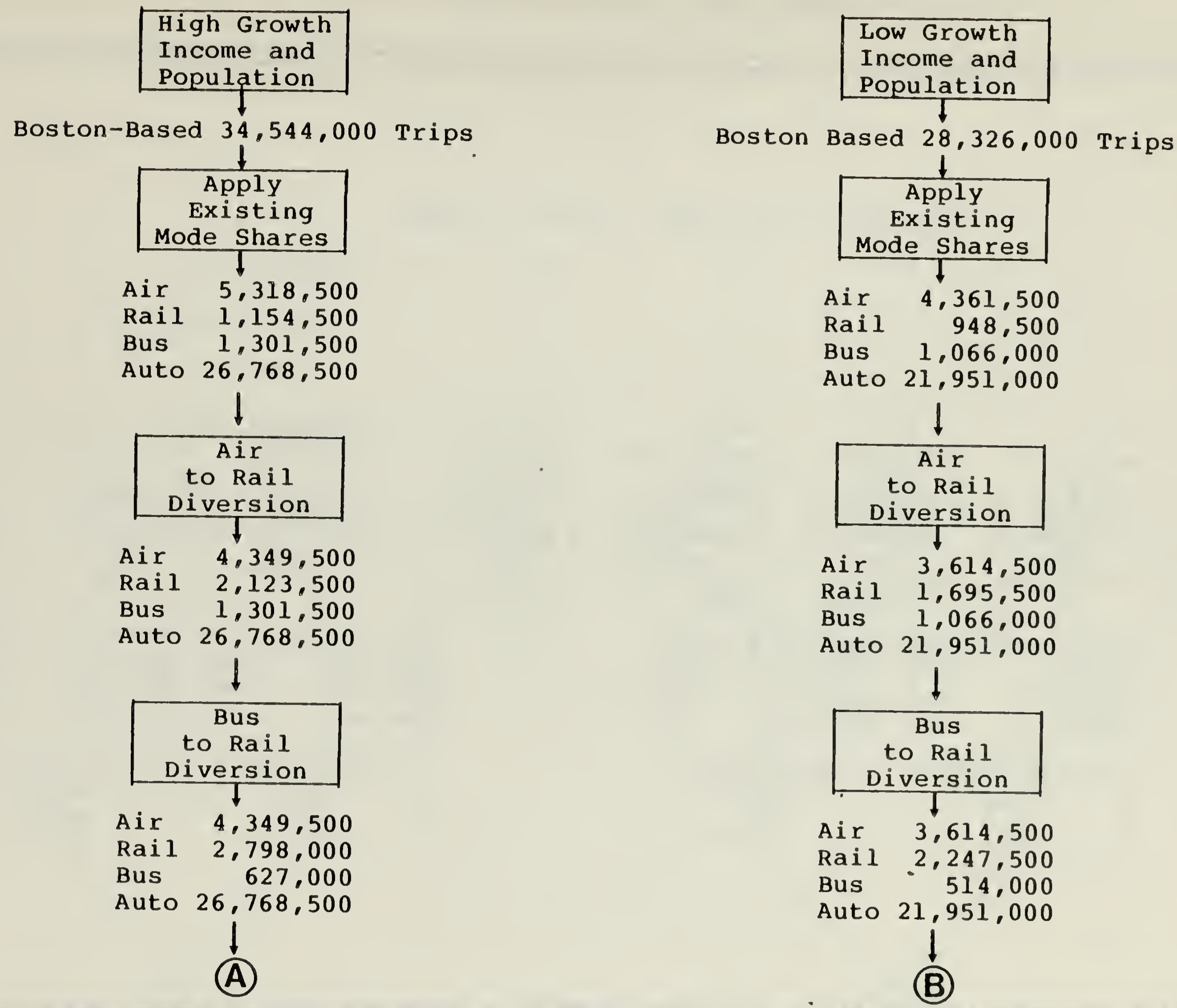

FIGURE 3-2 CALCULATION OF FORECAST ANNUAL RAIL RIDERSHIP AMTRAK

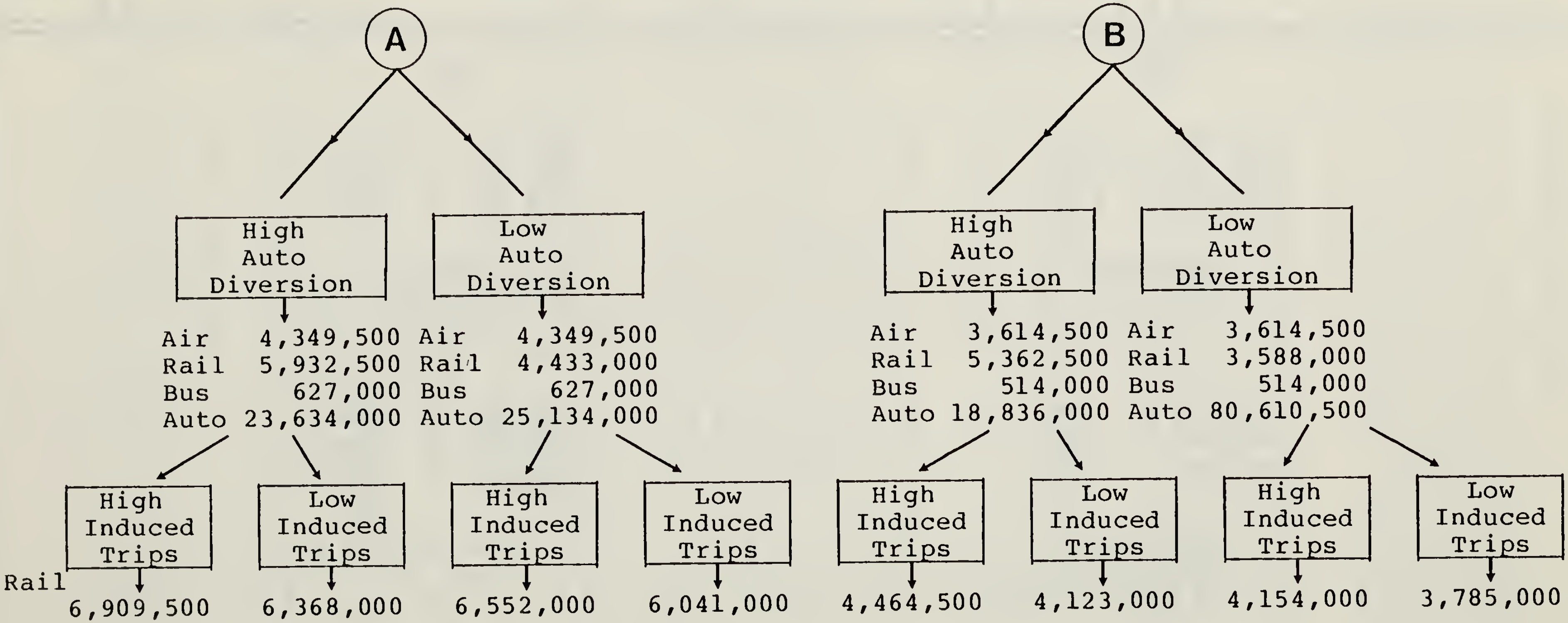

FIGURE 3-2 CONT.

CALCULATION OF FORECAST ANNUAL RAIL RIDERSHIP AMTRAK

	South Station	Back Bay	Route 128
Park-and-Ride	4.6%	2.4%	8.7%
Passenger	2.3%	1.1%	0.9%
Drop Off	4.6%	3.9%	2.5%
Rail Transit	23.1%	8.9%	0.0%
Bus	11.5%	5.9%	0.2%
Taxi	5.8%	4.5%	0.2%
Walk	5.8%	3.0%	0.2%
	57.7%	29.7%	12.5%

TABLE 3-3 BOSTON METROPOLITAN STATION BOARDINGS BY MODE AS A PERCENTAGE OF TOTAL AREA BOARDINGS

Income and Population Growth	Auto Diversions	Induced Travel	Design Day	Suburban Station Use (Bechtel Method)	70 Percent Park-and-Ride (Bechtel Method)	Existing Use of Route 128 (Alternative Method)
High Growth	High Diversion	High Induced	FRI Design Day	High Suburban Low Suburban	2,750 1,375	1,140
			MON-THU Design Day	High Suburban Low Suburban	2,316 1,158	960
		Low Induced	FRI Design Day	High Suburban Low Suburban	2,541 1,270	1,052
			MON-THU Design Day	High Suburban Low Suburban	2,142 1,071	887
	Low Diversion	High Induced	FRI Design Day	High Suburban Low Suburban	2,614 1,307	1,083
			MON-THU Design Day	High Suburban Low Suburban	2,205 1,102	913
		Low Induced	FRI Design Day	High Suburban Low Suburban	2,415 1,207	1,000
			MON-THU Design Day	High Suburban Low Suburban	2,026 1,103	840

TABLE 3-4

PARKING SPACE DEMAND FOR HIGH-SPEED INTERCITY RAIL

				Bechtel Method		Alternative Method
Income and Population Growth	Auto Diversions	Induced Travel	Design Day	Suburban Station Use	70 Percent Park-and-Ride	Existing Use of Route 128
Low Growth	High Diversion	High Induced	FRI Design Day	High Suburban Low Suburban	1,774 887	735
			MON-THU Design Day	High Suburban Low Suburban	1,501 750	622
		Low Induced	FRI Design Day	High Suburban Low Suburban	1,648 824	683
			MON-THU Design Day	High Suburban Low Suburban	1,386 693	574
	Low Diversion	High Induced	FRI Design Day	High Suburban Low Suburban	1,659 829	688
			MON-THU Design Day	High Suburban Low Suburban	1,396 698	578
		Low Induced	FRI Design Day	High Suburban Low Suburban	1,512 756	626
			MON-THU Design Day	High Suburban Low Suburban	1,270 635	526

TABLE 3-4 CONT.

PARKING SPACE DEMAND FOR HIGH-SPEED INTERCITY RAIL

Statistical Area (including the Boston, Lowell, Lawrence, Haverhill, and Brockton SMSA's) to be only .17 percent, which is even below the low-growth assumption of .67 percent. For this reason, it is suggested that those estimates related to high growth be disregarded.

3.3.2 Auto Diversion

The second assumption, which must be questioned, is that of high-auto diversion. This diversion assumes a relative doubling of auto costs and constant rail fares. In fact, since 1974, the Boston to New York fare has increased from $13.50 to $34.50. This rail increase more than matches the increases in auto costs--invalidating this assumption.

3.3.3 Induced Trips

Although they are not explicitly linked, it seems reasonable to assume that income and population growth and induced travel are related. Thus, since the high-growth assumption has been dismissed, it seems appropriate to assume that the high percentage of induced rail trips will also not occur.

3.3.4 Design Day and Allocation of Trips to Route 128

While AMTRAK rail boardings do show a Friday ridership peak, it seems reasonable to assume that many of these riders are also commuter rail patrons. If this is the case, then to avoid double counting, parking spaces for these patrons will be accounted for in the following section. With regard to suburban station use, there appears to be no compelling reason to assume a major shift in the metropolitan share of rail trips at Route 128 Station.

Sufficient population growth has occurred to the north of Boston, which is inconveniently located with regard to Route 128 Station, to make the doubling of the metropolitan share of ridership at Route 128 Station seem inappropriate.

3.3.5 Additional Factors

The outcome of the preceding analysis reduces the demand for parking to 500 to 700 spaces at Route 128 for AMTRAK patrons. It is worth noting now some additional factors that may reduce the demand at Route 128 Station further. The demands cited are based on the 4R Act times. These times can be reached only after further improvements are made beyond the current NECIP is completed. If, as is likely, the NECIP times remain the standard, the demand at Route 128 should be 10 percent less (450 to 625 spaces).

In addition, the current Metroliner service to New York, which nearly reaches the 3-hour and 40-minute NECIP goal, does not stop at Route 128 Station for half of its trips. (The morning trip from New York and the evening trip to new York do not stop at Route 128.)

If this pattern of reduced stops continues, the demand at Route 128 will be less than that shown above. For this reason, the 450- to 625-space demand should be considered an upper limit for AMTRAK parking demand.

4.0 COMMUTER RAIL PATRONAGE ESTIMATES

4.1 ESTIMATION OF FUTURE CONDITIONS AFFECTING PATRONAGE

The demand for commuter parking at Route 128 Station will be examined in light of several different conditions.

The first condition will relate to the price of gasoline and its effect on auto-operating costs. The low price of gasoline will be considered to be the existing $1.20 per gallon (recognizing fully that this is a high figure, with prices of $.97 per gallon being common now). The high price of gasoline will be considered to be $2 per gallon. For gasoline at $1.20, the corresponding auto-operating costs (in 1980 dollars) will be 15.3 cents per mile (fully allocated cost and 7.6 cent per mile (out-of-pocket cost). For gasoline at $2 per gallon, the costs are 25.5 cents per mile (fully allocated cost) and 12.8 cent-per-mile (out-of-pocket costs).

The second consideration will be the downtown parking cost. The low price of parking in downtown Boston will be the 1980 cost of $2.80 per day (weighted average of $4.34 for 35,179 spaces and assumed $0 for 20,258 restricted spaces, Reference 19). The high cost will be assumed to be triple that cost, or $8.40 per day. (All costs in 1980 dollars.)

The third consideration will be the parking cost at Route 128 Station and at other surrounding commuter rail stations. The extreme condition will be the imposition of a $1 per day parking cost at surrounding train stations equal to the existing $1 per day charge at Route 128 Station. Any situation with free parking at Route 128 Station and parking fees at other area stations has been dismissed as unrealistic. The extremes of these conditions will be then as shown in Table 4-1.

The estimates of the market for commuter rail trips will be assumed to be Home-Based Work trips to the Boston CBD. The actual number of these trips will be taken from the 1975 trip tables, prepared as part of the Alan M. voorhees (AMV) Planning Assistance Contract. From that trip table, the daily work trips from the six-town study area to the Boston CBD have been extracted and presented in Table 4-2.

The total work trip productions from the study area towns is assumed not to change. The population forecasts for five of the towns is expected to remain stable, and Walpole's population is expected to grow by only 15 percent between 1980 and 2010 (Reference 12).

	Case	Gasoline	CBD Parking	Station Parking
Extreme Values	1	$2.00/gallon	$8.40/day	$1.00/day
Existing Condition	2	$1.20/gallon	$2.80/day	free

FIGURE 4-1 EXTREME VALUES OF FACTORS AFFECTING COMMUTER PARKING

Origins	Destinations: Boston CBD	All Other Areas	Total
Brockton	1,400	24,200	25,600
Canton	875	4,025	4,900
Dedham	1,675	5,600	7,275
Norwood	1,225	7,250	8,475
Walpole	375	4,625	5,000
Westwood	725	3,075	3,800
All Other Areas	180,700	783,050	963,750
Total	186,975	831,825	1,018,800

TABLE 4-2

1975 HOME-BASED WORK, ONE-WAY TRIPS

Future employment forecasts for the Boston CBD are not available. It will be assumed that the percentage growth in CBD employment will be equal to the city of Boston's percentage growth. That growth is 8 percent between 1980 and 2010 (Reference 14). Given this increase in employment, it is assumed that, as a worst case, work trips from each town will increase by 8 percent.

4.2 AMV MODE SPLIT

4.2.1 Background on Method

As part of the Alan M. Voorhees (AMV) Planning Assistance Contract with the Massachusetts Department of Public Works, a mode split model was developed and calibrated. This model will estimate the number of transit and highway users from a traffic zone based on the relative utility of highway and transit modes.

4.2.2 Description of Method

The AMV model computes relative disutility of transit and highway travel based on the cost of travel of each mode. The disutilities tend to apply to tables calibrated for the Boston area, which estimate the percentage share of travel for each mode. The disutility formulas are shown below.

- TULT = 4.17 * ((IVTT + AAT) + 2.5 * OVTT) + ((AAT/3) * AOC) + FARE

Where:

- TULT = Transit Disutility
- IVTT = In-Vehicle Transit Time
- AAT = Auto Access Time
- OVTT = Out-of-Vehicle Transit Time
- AOC = Auto-Operating Cost (in 1963 cents/mile)
- FARE = Fare (in 1963 cents)
- 4.17 = Constant to convert time to cents (based on 1963 cents)
- 3 = Factor to convert auto-access minutes to miles (based on 20 mph)
- 2.5 = Weighting factor OVTT to IVTT

and:

- HULT = 4.17 * (IVHT + (2.5 *OVHT)) + ((AOC) * DIST + .5 * PARK))/AO

Where:

- HULT = Highway Disutility
- IVHT = In-Vehicle Highway Time
- OVHT = Out-of-Vehicle Highway Time
- AOC = Auto-Operating Cost (in 1963 cents/mile)
- DIST = Highway Distance
- PARK = CBD Parking Cost (in 1963 cents/mile)
- AO = Auto Occupancy (set at 1.6 persons/car)
- .5 = Conversion of round trip parking cost to one-way cost
- 4.17,= As above in transit
  2.5

As is apparent from the formulas, this mode split model will only make a division between highway trips and transit trips, in general. The end result for a town will be the percentage transit use (in this case, rail) from the town to the Boston CBD. In order to estimate the parking demand for commuter rail at Route 128 Station, it is suggested that the percentage that Route 128 Station is used by a town (see Table 2-3), and the percentage of boarders parking at the station (80 percent) be applied to the transit use from the town.

The values for many of the variables in the formula will remain constant throughout the analysis. These values have been taken from existing travel data and are shown below.

	Brockton	Canton	Dedham	Norwood	Walpole	Westwood
IVTT	24.0	24.0	24.0	24.0	24.0	24.0
AAT	16.7	7.2	5.0	5.9	8.5	3.9
OVTT	10.0	10.0	10.0	10.0	10.0	10.0
FARE	70.0	70.0	70.0	70.0	70.0	70.0
IVHT	58.0	50.0	43.0	54.0	59.0	46.0
OVHT	5.0	5.0	5.0	5.0	5.0	5.0
DISTANCE	20.3	20.1	13.5	18.0	24.8	14.5
AUTO OCCUPANCY	1.6	1.6	1.6	1.6	1.6	1.6

The values that will change between the existing situation and the extreme case are the auto-operating costs, the CBD parking costs, and the station parking fees. The station parking fees will be added to the train fare to commute out-of-pocket train cost. Since only transit, in general, is being modeled, it is not possible to include the impact of parking fees at other train stations. The values under the existing conditions and the extreme case are:

	Existing	Worst Case
Auto Costs, 1963 Cents/ Mile	7.2¢	12.0¢
CBD Parking in 1963 Dollars	$1.32 ($2.80 1980 Dollars)	$3.95 ($8.40 1980 Dollars)
Route 128 Station Parking	$ .47 ($1.00 1980 Dollars)	$ .47 ($1.00 1980 Dollars)

4.2.3 Forecasts of Parking Demand

For the values shown above, the following auto and highway disutilities can be calculated for each town:

AMV Disutilities

	Existing		Worst Case	
	Highway	Train	Highway	Train
Brockton	316	408	459	434
Canton	295	345	437	357
Dedham	247	331	369	339
Norwood	296	337	432	346
Walpole	339	354	496	367
Westwood	259	323	385	330

These disutilities, along with an assumed auto-per-person rate of 2.0 in each town, result in the following train usage, by percent, for each town.

	Existing Percent by Train	Worst Case Percent by Train	Percent Increase
Brockton	45%	65%	44%
Canton	50%	90%	80%
Dedham	45%	70%	55%
Norwood	55%	90%	64%
Walpole	60%	75%	24%
Westwood	64%	80%	24%

These mode shares for train appear unrealistically high compared to the actual 1970 journey-to-work figures from the U. S. Census, as shown below:

	Percent by Train to Boston CBD
Brockton	6.9%
Canton	37.5%
Dedham	27.7%
Norwood	32.4%
Walpole	58.8%
Westwood	22.9%

For this reason, it is recommended that instead of applying the calculated mode share by train that the percentage increase in calculated train mode share be applied to the existing use of Route 128 Station. The existing commuter rail usage of the lot is approximately 350 cars. The development of a percentage growth in train use should be based on the town's transit utility increase and weighted by the town's usage of Route 128 Station.

This increase would amount to a 47 percent growth under the extreme case. This would mean a parking demand for commuter rail of 514 spaces. Allowing for the cited 8 percent growth by 2010 in CBD employment, this would mean that, according to this method, the long-term commuter rail parking demand at Route 128 Station should be on the order of 555 spaces under the extreme conditions.

4.3 CSI MODE SPLIT METHOD

4.3.1 Background on Method

As noted previously, the AMV mode split model does not allow a separate mode share for commuter rail use from different rail stations to be calculated. One sketch planning mode split model, which may be used to differentiate between changes at different train stations, is the "worksheet" mode split method, as documented by Cambridge Systematics, Incorporated (CSI) (Reference 16). This model can accommodate several modes of transit, as well as separate-drive-alone and carpool-highway use.

4.3.2 Description of Method

The CSI method is essentially a "multi-nomial logit" formulation, which allocates modal shares based on the utility of each mode. The formula used to calculate the utility of each mode, which was calibrated on national data, is:

- $U_m = (-.015 * IVT_m) + (-.16 * OVT_m \div DIST_m) + (-29 * OPC_m \div \text{Income})$
- U_m = Utility of Mode m
- IVT_m = In-Vehicle Time, Mode m
- OVT_m = Out-of-Vehicle Time, Mode m
- $DIST_m$ = Trip Distance, Mode m
- OPC_m = Out-of-Pocket Cost, Mode m
- Income = Average Household Income

Further, the out-of-pocket cost for each mode can be considered as auto-distance times operating cost, plus any transit fares or parking fees. All auto costs are shared by the number of occupants in the auto. For this method, the same Route 128 and drive-alone-highway travel times, as shown in the AMV method, can be used. For carpools, an average auto occupancy is assumed to be 2.6 persons per car, and the out-of-vehicle penalty is set to 10 minutes. For the other train station mode, the dominant station in the town (as identified in Table 4-3) is used to establish fares, parking fees, and travel time (including auto access). The household income value is the average household income cited by the 1980 U. S. Census (Reference 13). The values, which do not vary under the analysis, are shown in Table 4-3.

4.3.3 Forecasts of Parking Demand

Those values, which vary in the existing and extreme cases, are auto-operating cost per mile, CBD parking fees, and station parking fees. The existing condition and "extreme" values are shown in Table 4-4. With these values, it is possible to calculate the utility from each town for each of the four modes

	Brockton	Canton	Needham	Norwood	Walpole	Westwood
Route 128 Station						
•In-Vehicle Time (minutes)	24.0	24.0	24.0	24.0	24.0	24.0
•Auto Access Time (minutes)	16.7	7.2	5.0	5.9	8.5	3.9
•Out-of-Vehicle Time (minutes)	10.0	10.0	10.0	10.0	10.0	10.0
•Train Fare (1980 dollars)	$1.50	$1.50	$1.50	$1.50	$1.50	$1.50
Other Train Station						
•In-Vehicle Time (minutes)	38.0	27.0	19.0	29.0	34.0	23.0
•Auto Access Time (minutes)	10.0	3.0	2.5	3.0	3.0	3.0
•Out-of-Vehicle Time (minutes)	10.0	10.0	10.0	10.0	10.0	10.0
•Train Fare (1980 dollars)	$2.00	$1.75	$1.50	$1.75	$2.00	$1.75
Auto						
•In-Vehicle Time (minutes)	58.0	50.0	43.0	54.0	59.0	46.0
•Distance (miles)	20.3	20.1	13.5	18.0	24.8	14.5
•Out-of-Vehicle Time (minutes)	5.0	5.0	5.0	5.0	5.0	5.0
Household Income (1980 dollars)	$15,309	$25,642	$22,337	$21,782	$25,188	$29,398

TABLE 4-3 INPUT VARIABLES FOR CSI MODE SPLIT MODEL, ALL CASES

	Existing	Extreme Case
•Auto Out-of-Pocket Cost (1980 dollars)	7.6¢/mile	12.8^{d}/mile
•CBD Parking Fee (1980 dollars)	$2.80	$8.40
•Route 128 Parking Fee (1980 dollars)	$1.00	$1.00
•Other Station Parking Fee (1980 dollars)	$0.00	$1.00

TABLE 4-4 INPUT VARIABLES FOR CSI MODE SPLIT MODEL, BY CASE

(Route 128 Station train, other station train, drive alone, carpool). These utilities are then input to the "logit" equation to calculate the mode shares from each town. These mode shares for the existing conditions and extreme case are shown below:

Use of Route 128 Station
Percent of HBW Trips

	Actual*	Calculated Existing	Extreme Case	Percent Increase
Brockton	1.0%	27%	33%	22%
Canton	5.6%	28%	31%	11%
Dedham	0.5%	25%	29%	16%
Norwood	0.6%	22%	25%	14%
Walpole	8.8%	23%	26%	13%
Westwood	6.6%	27%	30%	11%

*U. S. 1970 Census adjusted by station use from town (CRIP Survey).

Like the AMV model, this method tends to overstate Route 128 Station use. This is only to be expected at this town level, limited mode analysis. While this model has less of an obvious overstatement, it still tends to overestimate, because it does not consider alternate modes of access to Boston (especially MBTA and commuter bus) or to the train stations (especially walking), and the distances used are town averages. Still, as a "pivot" type analysis, it does allow the calculation of a weighted average of 14 percent increase in train boardings at Route 128 Station under the extreme case. The increase is less than the AMV method, because additional mode share can be assigned also to other train stations and to carpools in the event of price increases in parking and gasoline.

Using this weighted average increase and the existing use at the station of 350 spaces (as cited previously), a demand of 399 spaces can be expected for commuter rail parking. Given also an 8 percent growth in trips because of employment growth, a long-run demand of 430 spaces may be needed under the extreme case.

5.0 CARPOOLING DEMAND FORECAST

5.1 FORECASTS OF CARPOOLING DEMAND

The Route 128 Station, because of its convenient location off the expressway network and its secure parking, appeals to some carpoolers. At present, this number is insignificant (30 cars per day, at most). The CSI mode share method outlined above does deal with carpools, but obviously most carpoolers from the study area either arrange for pick ups at their homes or at some other locations without a parking fee.

Therefore, it is probably appropriate to also only deal with the growth in carpooling under the worst case and to apply that to existing use.

As it happens, net carpool mode share remains unchanged in the extreme case, according to the CSI model. The decrease in auto use is solely in the drive-alone market. For this reason, it is expected that there will be only an insignificant growth in the use of Route 128 Station as a carpool staging area.

6.0 SUMMARY AND CONCLUSION

6.1 SUMMARY

The demand for parking at Route 128 Station will be related to the ridership growth in primarily two markets: AMTRAK intercity ridership and MBTA commuter rail ridership. The growth in AMTRAK ridership has been studied largely by the Federal Rail Administration, as part of the Northeast Corridor High Speed Rail Project. The growth in MBTA commuter rail ridership has been identified as part of the Commuter Rail Improvement Program. The purpose of this memorandum is to examine these reports and to prepare an estimate for the demand for parking at Route 128 Station under the extreme conditions.

The Northeast Corridor Project has forecast a range of intercity rail ridership from Boston for its long-range travel time goals. This range results because of the application of high and low assumptions at various points in the demand methodology. The figure of 2,200 spaces, often cited as the AMTRAK parking needs at Route 128, is the result of the continual application of the "high" assumption at each step in the demand forecast.

Several of the "high" assumptions of the Northeast Corridor method must be seriously questioned. In particular, the high population and income growth, the high auto diversion, and the high suburban station use assumptions appear unrealistic in light of present developments. The high population and income growth assumption calls for a much higher population and income growth (similar to growth over the period 1950 to 1960), which has not been the case over the recent past. Ignoring the high growth assumptions lowers the extreme-case parking demand for AMTRAK to 1,775.

The high auto diversion assumption must also be questioned. This diversion was based on a doubling of the 1974 ratio of auto-operating costs to rail fares. In reality, the increase in rail fares since 1974 (Boston to New York from $13.50 to $34.50 over the period) has kept pace with increases in auto-operating costs. Dropping the high auto diversion assumption, as well, lowers the parking demand to 1,650 spaces.

If the rise of Route 128 Station in the Boston metropolitan area continues at its current usage (approximately 9 percent of all boardings in the metropolitan area park at Route 128), the high suburban station use must also be questioned. A continuation of the existing use of Route 128 Station would result in a reduction of the peak parking demand to 688 spaces. If further the number of new induced trips to rail were expected to follow a low estimate, the highest use expected for Route 128 would be 625 spaces.

These estimates assume the achievement of the long-range goal of a three-hour travel time by rail from Boston to New York. If instead the current NECIP project's time of three hours and forty minutes were to remain the standard, the demand for parking would be 10 percent less, or 550 spaces.

These figures also assume a Friday design day. If the lower Monday through Thursday usage is used for design, the demand would be reduced by 15 percent--450 to 550 spaces.

For MBTA commuter rail parking demands, the impact of parking charges and increases in auto-operating expenses were examined. The extreme-case assumptions for this analysis called for a 200-percent increase in CBD parking cost, a parking fee imposition of $1 per day at surrounding train stations (or an elimination of the fee at Route 128), and a gasoline cost of $2 per gallon. Using the Alan M. Voorhees (AMV) mode split curves, an increase in train use of 59 percent is forecast. When applied to the existing demand at the station of approximately 350 cars, this would mean a demand of 550 spaces.

The AMV method does not account for changes in auto use (higher auto occupancy) or increased use of surrounding stations. For this reason, the CSI mode split model was also used to measure the impact of the extreme-case conditions. This results in a forecast increase of 23 percent in Route 128 Station use. This would require 430 spaces.

Carpool demand at Route 128 Station is insignificant at present--less than 30 cars per day. The attraction of Router 128 Station is the presence of attended parking for a carpool staging area. The growth in carpooling under the extreme-case conditions, according to the CSI mode split model, is balanced by a loss of current carpoolers to the train. This would imply that the future carpool use at Route 128 will be no more than the present.

6.2 CONCLUSION

The conclusion of this analysis is that demand for parking at Route 128 Station under the extreme conditions could be as much as 1,200 spaces. This is composed of 625 AMTRAK spaces, 550 commuter rail spaces, and 25 carpoolers.

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